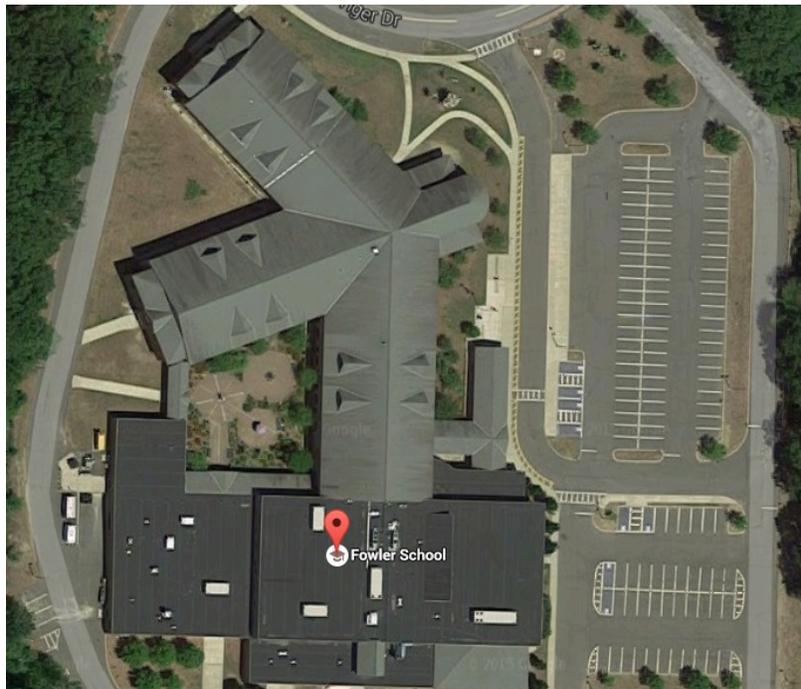


INDOOR AIR QUALITY ASSESSMENT

**Fowler Middle School
3 Tiger Drive
Maynard, Massachusetts**



Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health
Indoor Air Quality Program
December 2015

Background

Building:	Fowler School (FS)
Address:	3 Tiger Drive, Maynard, MA
Assessment Requested by:	Aaron Miklosko, Facilities Manager, Town of Maynard
Date of Assessment:	November 23, 2015
Bureau of Environmental Health/Indoor Air Quality (BEH/IAQ) Program Staff Conducting Assessment:	Ruth Alfasso, Environmental Engineer/Inspector
Date of Building Construction:	2001
Reason for Request:	Anonymous complaint about general conditions

Building Description

The Fowler School (FS) is a two story brick and concrete building completed in 2001. The school contains general classrooms, resource rooms, science rooms, a wood shop, office space, a cafeteria, auditorium and gymnasium. One wing of the FS currently houses the district's administrative offices. Windows throughout the building are openable.

Results and Discussion

Approximately 400 students in grades 4-8 occupy this space, as well as approximately 150 staff. Test results are presented in Table 1. Methods and indoor air related sampling information can be found in the IAQ Manual and Appendices for IAQ Reports, which can be found at:

<http://www.mass.gov/eohhs/gov/departments/dph/programs/environmental-health/exposure-topics/iaq/iaq-rpts/general-appendices-for-iaq-reports.html>

Ventilation

It can be seen from Table 1 that carbon dioxide levels were below 800 parts per million (ppm) in all but two out of the 69 areas tested, indicating adequate ventilation in the school. Mechanical ventilation for classrooms, offices and common areas is provided by air handling units (AHUs) located in a mechanical space above the second floor of the classroom wings (Picture 1) and on the roof for the common areas. AHUs in the mechanical space draw air from intakes located in the roof (Picture 2). Fresh air is distributed via ceiling-mounted supply vents (Picture 3). Exhaust is provided by ceiling-mounted exhaust vents ducted back to AHUs (Picture 4). Direct venting of exhaust is provided in bathrooms and some other areas. Note that in some areas, such as the nurses' office, weak or non-existent draw of air was observed from exhaust vents. These vents are necessary to remove bathroom odors and moisture and should be repaired if they are not functioning.

The AHUs for common areas provide cooling as well as heating. Additional cooling for the administrative wing and some classrooms is provided by window-mounted air conditioners (Picture 5).

Temperature and Relative Humidity

Indoor temperature measurements ranged from 68°F to 72°F (Table 1), which were within or close to the lower end of the MDPH recommended comfort range. The MDPH recommends that indoor air temperatures be maintained in a range of 70°F to 78°F in order to provide for the comfort of building occupants. Occupants in some areas expressed complaints with cold temperatures. Occupants should work with facilities staff to adjust temperatures as the seasons change.

Indoor relative humidity ranged from 11 to 28 percent (Table 1) which was below the MDPH comfort range and reflective of outdoor conditions. The MDPH recommends a comfort range of 40 to 60 percent for indoor air relative humidity. Relative humidity levels in the building would be expected to drop during winter months due to heating. The sensation of dryness and irritation is common in a low relative humidity environment. Low relative humidity is a very common problem during the heating season in the northeast part of the United States.

Microbial/Moisture Concerns

Water-damaged ceiling tiles were observed in many classrooms and other areas (Pictures 3 and 6; Table 1). These reportedly originate from intermittent roof leaks. Water-damaged ceiling tiles can provide a source of mold and should be removed and replaced when leaks are discovered and repaired. However, no mold staining was visible on any of the tiles examined.

The exterior of the building was examined for potential water penetration and drainage issues. A few doors were observed to be missing weather stripping which can allow unconditioned air, moisture and pests into the building.

Indoor plants were also observed in some areas, which can introduce pollen or mold indoors (Picture 7; Table 1). Plants should be kept away from sources of airflow which may distribute particles, pollen, mold and odors. Plants should be properly maintained, over-watering of plants should be avoided and drip pans should be inspected periodically for mold growth and cleaned or replaced as necessary. An aquarium and a terrarium were observed in classrooms, these should also be well maintained to prevent odors.

Water dispensing equipment and small refrigerators were observed in carpeted areas (Table 1). Spills or leaks from this equipment can moisten carpet and lead to microbial growth and carpet degradation. Some refrigerators examined had gaskets that were stained with mold (Picture 8); these should be cleaned with an antimicrobial solution or replaced. Refrigerators should be cleaned out regularly to prevent odors from spilled/spoiled food.

Some sinks were found to have backsplashes which had gaps where water can penetrate the seam and cause damage to underlying wood. These should be repaired with appropriate caulking material.

Other IAQ Evaluations

IAQ can be negatively influenced by the presence of respiratory irritants, such as products of combustion. The process of combustion produces a number of pollutants. Common combustion emissions include carbon monoxide, carbon dioxide, water vapor, and smoke (fine airborne particle material). Of these materials, exposure to carbon monoxide and particulate matter with a diameter of 2.5 micrometers (μm) or less (PM_{2.5}) can produce immediate, acute health effects upon exposure. To determine whether combustion products were present in the indoor environment, BEH/IAQ staff obtained measurements for carbon monoxide and PM_{2.5}

Carbon Monoxide

Carbon monoxide should not be present in a typical, indoor environment. If it is present, indoor carbon monoxide levels should be less than or equal to outdoor levels. Carbon monoxide levels outdoors were measured at 0.8 ppm likely from traffic. No carbon monoxide was detected inside the building during the assessment.

Particulate Matter

Outdoor PM_{2.5} concentrations were measured at 7-16 µg/m³ (Table 1), which were below the NAAQS limit of 35 µg/m³. Indoor PM_{2.5} levels ranged from 3 to 39 µg/m³ (Table 1), all but one were below the NAAQS PM_{2.5} level of 35 µg/m³. The level above the NAAQS limit was in the B wing team room, which may be due to the presence of photocopying in this room. Frequently, indoor air levels of particulate matter (including PM_{2.5}) can be at higher levels than those measured outdoors.

Volatile Organic Compounds (VOCs)

Exposure to low levels of total VOCs (TVOCs) may produce eye, nose, throat and/or respiratory irritation in some sensitive individuals. In order to determine if VOCs were present, BEH/IAQ staff examined rooms for products containing VOCs. BEH/IAQ staff noted air fresheners, hand sanitizer, cleaners and dry erase materials in use within the space (Table 1). All of these have the potential to be irritants to the eyes, nose, throat and respiratory system of sensitive individuals.

Other Concerns

Other conditions that can affect IAQ were observed during the assessment. The woodshop area had task-based exhaust/vacuum systems that emptied into a collection system outside the building (Picture 9). This system should be used as needed to collect wood chips/shavings and maintained, including emptying the receptacle of sawdust/chips on a regular basis. Sawdust can be a source of mold, and can provide harborage for pests.

Tennis balls were observed sliced open and used at the bottom of table and chair legs (Picture 12). Tennis balls are made of a number of materials that are a source of respiratory

irritants. Constant wearing of tennis balls can produce fibers and off-gas VOCs. Tennis balls are made with a natural rubber latex bladder, which becomes abraded when used as a chair leg pad. Use of tennis balls in this manner may introduce latex dust into the school environment. Some individuals are highly allergic to latex (e.g. spina bifida patients) (SBAA, 2001). It is recommended that the use of materials containing latex be limited to reduce the potential for symptoms in sensitive individuals (NIOSH, 1997). Latex-free glides should be used for this purpose.

Some personal fans and supply/exhaust vents were observed to be dusty (Picture 10). Dust on these items can be reaerosolized and cause irritation or odors. A pencil sharpener with shavings spilling out of it was located in front of a personal fan (Picture 11). Pencil shavings can be a source of irritation, and should be kept contained and emptied frequently to avoid becoming airborne and should not be in the airstream of ventilation equipment or fans.

Worn carpeting was observed in some areas. Carpeting that is worn can produce particulates as it ages. Other carpeting should be cleaned annually, or semi-annually in soiled high traffic areas, as per the recommendations of the Institute of Inspection, Cleaning and Restoration Certification (IICRC, 2012).

Filters are present in the AHUs for the building. These filters should be changed on a regular schedule. Window air conditioners also have filters that should be cleaned regularly.

Conclusions/Recommendations

In view of the findings at the time of the visit, the following recommendations are made:

1. Replace water-damaged ceiling tiles promptly. Make necessary repairs to roof and plumbing to reduce water damage from occurring in the future.
2. Operate HVAC equipment continuously during occupied hours.
3. Investigate draw of air from exhaust vents in bathrooms and other areas and repair if necessary.
4. Work with facilities staff to adjust temperatures for occupied areas.
5. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. To control for dusts, a high efficiency particulate arrestance

- (HEPA) filter equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended. Avoid the use of feather dusters. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).
6. Repair/replace weather stripping for exterior doors to prevent the entry of unconditioned air, moisture and pests. Monitor for light or drafts around doors.
 7. Maintain indoor plants, use non-porous drips pans, prevent overwatering and refrain from placing them near ventilation equipment.
 8. Maintain aquariums and terrariums to prevent odors.
 9. Consider placing water dispensers/small refrigerators in non-carpeted areas or place a waterproof mat underneath them.
 10. Clean out refrigerators often. Clean gaskets with an antimicrobial solution or replace when stained.
 11. Repair/caulk backsplashes on sinks to prevent water penetration.
 12. Reduce the use of items containing VOCs including scented cleaners, air fresheners, dry erase materials and hand sanitizer. Only school-issued products should be used and products should not be brought in from outside.
 13. Use and maintain the sawdust collection system in the wood shop, including regular emptying of the collection receptacle.
 14. Use the exhaust vent for the kiln whenever the kiln is in operation. Keep the kiln area clear of materials, particularly flammable materials and those that may off-gas when heated.
 15. Clean surfaces, vents, window air conditioner filters and personal fans regularly. Change AHU filters on a preventative maintenance schedule.
 16. Clean carpeting annually or semi-annually in soiled high traffic areas as per the recommendations of the Institute of Inspection, Cleaning and Restoration Certification (IICRC, 2012). Consider a schedule for replacing any worn carpeting that is beyond its service life.
 17. Refer to resource manuals and other related indoor air quality documents for further building-wide evaluations and advice on maintaining public buildings. These materials are located on the MDPH's website: <http://mass.gov/dph/iaq>.

References

IICRC. 2012. Carpet Cleaning FAQ 4 Institute of Inspection, Cleaning and Restoration Certification. Institute of Inspection Cleaning and Restoration, Vancouver, WA.

NIOSH. 1997. NIOSH Alert Preventing Allergic Reactions to Natural Rubber latex in the Workplace. National Institute for Occupational Safety and Health, Atlanta, GA.

SBAA. 2001. Latex In the Home And Community Updated Spring 2001. Spina Bifida Association of America, Washington, DC.

Picture 1



Air handling unit in mechanical space

Picture 2



Air intakes at top of roof

Picture 3



Ceiling-mounted supply vent (note water-damaged ceiling tile)

Picture 4



Return vent

Picture 5



Window-mounted air conditioner

Picture 6



Water-damaged ceiling tiles

Picture 7



Plants on porous materials

Picture 8



Stained refrigerator gasket

Picture 9



Woodshop sawdust exhaust

Picture 10



Tennis balls used as chair and table glides

Picture 11



Dusty personal fan and pencil shavings in front of fan

Location: Fowler Middle School
Address: 3 Tiger Drive, Maynard, MA

Indoor Air Results
Date: 11/23/2015

Table 1

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 (µg/m ³)	Occupants in Room	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
Background	395	0.8	40	18	7-16					Sunny, cold, light wind
A team room	545	ND	70	16	18	1	Y	Y	Y	Food, carpet, fridge on carpet
A102	341	ND	69	12	4	2	Y	Y	Y	WAC, PF, NC
A103	323	ND	70	11	3	0	Y	Y	Y	Plants, WAC, DEM, NC
A104	340	ND	70	11	4	2	Y	Y	Y	Plants, DEM, PC, WAC
A108 staff lunch	325	ND	70	12	3	0	Y	Y	Y	Food, fridge, food odors, NC
A109	324	ND	70	11	5	0	Y	Y	Y	WAC, plants, DEM, NC
A110	380	ND	70	13	4	2	Y	Y	Y	WAC, plants
A201	798	ND	71	19	13	Some students just left	Y	Y	Y	TBs, DEM, WD CT
A202	561	ND	71	15	3	1 plus some left	Y	Y	Y	DEM

ppm = parts per million CT = ceiling tile MT = missing tile PF = personal fan WD = water-damaged
µg/m³ = micrograms per cubic meter DEM = dry erase materials NC = non-carpeted TB = tennis balls
ND = non detect HS = hand sanitizer PC = photocopier WAC = window air conditioner

Comfort Guidelines

Carbon Dioxide: < 800 preferred > 800 ppm = indicative of ventilation problems	Temperature: 70 - 78 °F Relative Humidity: 40 - 60%
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Table 1 (continued)

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 (µg/m ³)	Occupants in Room	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
A203	577	ND	70	15	10	5 plus some left	Y	Y	Y	NC, PF dusty, DEM
A204	482	ND	70	14	5	0	Y	Y	Y	DEM, quiet room with supply/exhaust, 2 MT
A207	727	ND	70	17	8	~20 just left	Y	Y	Y	TBs, DEM, NC
A208	735	ND	71	16	21	~21 just left	Y	Y	Y	DEM, plants
A209	635	ND	70	16	4	9	Y	Y	Y	TB, NC, DEM
A210	749	ND	70	16	11	15	Y	Y	Y	NC, DEM, sink (backsplash open)
After School Area	596	ND	70	24	5	1	N	Y	Y	Fan, plush furniture, NC
Auditorium	454	ND	68	15	4	0	N	Y	Y	
B team room	633	ND	70	17	39	3	Y	Y	Y	Carpet
B101	411	ND	70	15	4	2	Y	Y	Y	DEM, rubber mats, rocks and dirt

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Table 1 (continued)

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								Supply	Exhaust	
B102	397	ND	70	13	3	1	Y	Y	Y	NC, area rug, beanbag chairs, sink, fridge
B103	401	ND	71	15	3	1	Y	Y	Y	Area rugs, TBs, items
B104	362	ND	70	12	5	0	Y	Y	Y	DEM, WD CT (many), plant
B112	418	ND	70	14	5	1	Y	Y	Y	DEM, area rug, 2 WD CT
B113	410	ND	70	13	3	1	Y	Y	Y	Area rug, sink, NC
B114	427	ND	71	14	3	1	Y	Y	Y dusty	Area rug, PF
B115	385	ND	71	13	3	0	Y	Y	Y	DEM, WD CT
B201	690	ND	71	17	5	20	Y	Y	Y	DEM, PF, WD CT, HS
B202	800	ND	71	18	7	20	Y	Y	Y	DEM, PF, WD CT
B203	552	ND	71	15	5	0	Y	Y	Y	WD CT, WAC, DEM, carpet

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								Supply	Exhaust	
B204	726	ND	70	18	12-18	20	Y	Y	Y	Terrarium, plants
B211 computers	539	ND	70	15	10	14	Y	Y	Y	NC
B212	759	ND	70	18	5	17	Y	Y	Y	WD CT, PF, NC
B213	679	ND	70	18	14	24	Y	Y	Y	PF, WD CT, DEM, NC
B214	569	ND	71	16	20-24	0	Y	Y	Y	TB, WAC
B220 computer	706	ND	71	15	9	10	Y	Y	Y	30 computers, WD CT
C team room	545	ND	71	16	3	0	N	Y	Y	Worn carpet, PCs, WC on carpet, toaster and fridge, stand fan
C204	475	ND	69	16	4	2	Y	Y	Y	Area rug, CT
C205	589	ND	70	16	4	8	Y	Y	Y	Area rug, 3 WD CT, HS, DEM
C206	811	ND	70	18	8	15	Y	Y	Y	NC – area rugs, DEM

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								Supply	Exhaust	
C207	542	ND	70	15	6	2	Y	Y	Y	NC and area rugs, HS
C209	551	ND	70	16	6	7	Y	Y	Y	NC, HS, DEM, storeroom
C210	621	ND	70	16	11	0	Y	Y	Y	Area rug, DEM, 2 WD CT
C211	660	ND	70	18	15	16	Y	Y	Y	DEM, plants, area rug
C212	461	ND	69	16	4	0	Y	Y	y	NC, aquarium, DEM
C213	503	ND	70	15	7	4	Y	Y	Y	WD CT, NC, microwave, fridge, DEM, HS
Cafeteria	688-727	ND	70	21	12-23	~70	Y	Y	Y	Doors to outside
D team room	556	ND	70	16	25	6	Y	Y	Y	PF, carpet
D202	613	ND	69	21	16	5	N	Y	Y	WD CT, DEM, NC, kitchen equipment, ovens, dishwashers, etc.
D204	582	ND	71	20	22	0	N	Y	Y	Many WD CT, and missing CT

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								Supply	Exhaust	
D206 (wood shop)	606	ND	70	20	5	0	Y	Y	Y	Wood chips/saw dust, dust collection equipment
D215	471	ND	70	22	5	0	Y	Y	Y	DEM, items
Guidance	461	ND	70	17	18	1	Y	Y	Y	DEM, carpet, plants
Gym	564	ND	71	28	5	0	N	Y	Y	Rubber/gym items, DEM
Janitorial Chemical storage							N	Y	Y	
Kiln room							N	N	Y	Kiln vented to outside, direct exhaust
Library	368	ND	69	15	3	0	N	Y	Y	Carpet, DEM
Library control room	390	ND	69	16	3	3	Y	Y	Y	Plants, NC
Main office area	559	ND	70	20	8	2	Y	Y	Y	PC, plants
Main office conference room	741	ND	70	21	7	2	Y	Y	Y	WD CT

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								Supply	Exhaust	
Mrs. Cotter	443	ND	69	17	11-29	0	Y	Y	Y	DEM, carpet
Mrs. Hatch	456	ND	70	17	19	0	Y	Y	Y	Plants, carpet, HS
Ms. Morrow	495	ND	69	19	5	0	N	N	Y	WD CT
Music Classroom	495	ND	72	20	6	2	Y	Y	Y	NC, sink, 3 WD CT, door to outside
Music office	695	ND	71	22	5	0	Y	Y	Y	Instruments, NC
Music Storage										Instruments, some dust, dry
Nurses' office	449	ND	69	16	12	3	N	Y	Y	
Nurses' office bathroom									Y	Exhaust off or weak
Nurses' suite	453	ND	69	16	21	1	N	Y	Y	
Practice room B	605	ND	71	20	3	0	N	Y	N	NC

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								Supply	Exhaust	
Principal's office	632	ND	70	18	8	1	Y	Y	Y	Plant
Superintendent's office	355	ND	70	14	11	1	Y	Y	Y	Plants, DEM
Teachers room	319	ND	69	11	3	0	Y	Y	Y	Fridge, microwave, PC
Teachers' room off office area	444	ND	69	15	5	1	N	Y	Y	NC, PC
Unisex adult restroom							N	N	Y	Exhaust off or weak, vent dusty, bathroom odors

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